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Selecting Environmentally Responsible Sealing Solutions

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The first step in selecting environmentally responsible sealing solutions is to define the term, environmentally responsible. This is not as straightforward as it sounds, since it can be defined in regulatory terms, by corporate policy, or by moral and ethical standards. The term can also be extended to include resource conservation, as well as emissions reduction.

Fluid sealing devices play a critical role in a wide range of processing industries, including chemicals, refining, pulp and paper and many others. In this role, they variously keep pumps from leaking, valves from releasing emissions, flanges from spraying fluids and other undesirable and often dangerous conditions.

The process of selecting the environmentally responsible sealing solution for any given application begins with defining the expected level of performance and service conditions. In the process of delivering satisfactory environmental performance, it should help improve overall process productivity and reduce or eliminate damage to plant and equipment, downtime, lost production and non-compliance penalties. It should also help conserve raw materials and the energy it requires to operate the process.

A holistic approach to environmentally responsible sealing solutions is based on the regulations and standards of various agencies such as the FDA, EPA, USP, 3A and others. Compliance with these regulations often calls for sealing effectiveness to the ppm level, and most sealing manufacturers can provide certificates of conformance for their products. In some applications, particularly refineries, the sealing solution must also be fire-safe or fire-resistant for flammable fluid service.

TAMPSS

A simple acronym, **TAMPSS** (temperature, application, media, pressure size and speed) provides a general guide to ensuring selection of the correct sealing device for your application.

Temperature. The first consideration should be the temperature of the fluid contacting the seal, which will increase in rotating equipment due to frictional heat. Knowing this temperature will immediately reduce the number of viable materials.

Application. How is the seal to be used-on a rotating pump shaft, raised-face flange, valve stem, etc.? Defining the application's parameters demands often difficult-to-obtain, but necessary information about the equipment in which the seal will be installed. This information also helps determine installation procedures to optimize seal performance.

For gaskets, you need to know the type of flanges on which they will be installed, as well as material and bolting information to determine the amount of compressive force available. These are extremely important factors, since more than 70 percent of gasket failures can be attributed to insufficient load.

Choice of compression packing for pumps and valve stems depends on whether the stem motion is reciprocating, helical or rotating.

Media. Either the common or chemical name of the gas, liquid or solid that will come into contact with the seal can be used to determine its compatibility with the seal material. Also consider any secondary media to which the seal may be exposed, such as fluids that are intermittently present during chemical or steam/hot water flushing. The sensitivity of the media to color contamination or extracted materials leached from the seal should also be taken into account.

Pressure. Most systems operate at fairly consistent pressure, but it is important to take into account any severe spikes or surges that may occur.

Size. ASME B16.5, B16.20, B16.21 and B16.47 provide standard dimensions for flanges and gaskets. Required information includes nominal pipe size and flange class. Most pumps and valves conform to API/ANSI standards; otherwise, they must be field measured.

Speed. Surface speed in RPM at the seal-shaft interface is crucial in selecting pump packing. The actual surface speed of two pumps operating at the same RPM with different shaft diameters will differ. Surface speed indicates how much frictional heat will be generated; high speeds call for materials that can withstand and effectively dissipate heat.

Environmental Service Criteria

To these criteria, we can add environmental service criteria, notably liquid leaks requiring spill response, fugitive emissions, water conservation and energy consumption.

When a gasketed joint of a gear box or lube oil system drips fluid on the floor or walls, it is a nuisance leak that should be cleaned up before it results in slips, falls and injuries. If the same leak occurs outdoors, it contaminates the ground and becomes an environmental issue requiring spill response. Aside from the cost and inconvenience of cleanup, the incident may have to be documented and local and state authorities notified regarding the possibility of contamination of ground water, flora and fauna.

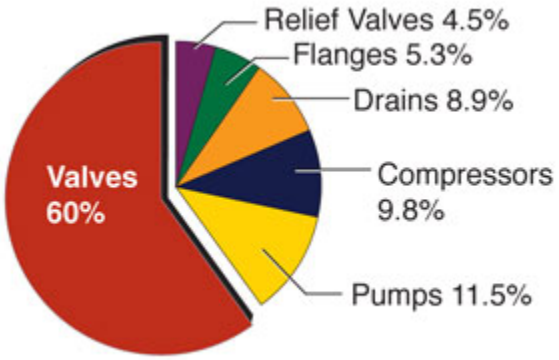
A typical scenario for such an event might involve a gasket in an oil pan joint that over time begins to ooze oil, even though the temperature is not extreme and the pressure is nearly atmospheric. At first, the edge of the gasket becomes wet, followed by streaks of oil staining the bottom of the pan and then actual leakage.

Why was this seemingly simple application leaking? The oil pan joint, like many, did not have enough bolts to adequately compress the gasket and attain an effective seal. Due to years of use, the pan was not perfectly flat, and the wrong type of gasket was selected. Fortunately, there are gasket materials readily available to address this issue and resolve the problem.

Fugitive Emissions

Most fugitive emissions of volatile organic compounds (VOCs) and other hazardous air pollutants (HAPs) are released by the automotive industry (35 percent), followed by the chemical industry (30 percent), oil and gas (20 percent) and other sources (15 percent). Leaking valves stems account for the vast majority of these emissions (see Figure 1).

Figure 1. Leaking valve stems account for 60 percent of fugitive emissions, followed by pumps, compressors, drains, flanges and relief valves.



Equipment requiring sealing compliance.

Containment of these emissions is governed by law, which the EPA enforces. Beyond complying with the letter of the law, environmental responsibility calls for taking to heart the spirit of the law-proactively finding, minimizing and ideally stopping harmful substances from entering the air.

The Kyoto Protocol has brought into sharp focus the need to reduce greenhouse gases (GHGs) from our industrial processes. Yet many VOCs and HAPs are many times more potent GHGs than much maligned carbon dioxide. Standards such as API 622, ISO 15848, TA-Luft and others address the ability of packing and gaskets to achieve low levels of fugitive emissions.

Water Conservation

Power plants, refineries, chemical processors, paper mills and other industrial facilities require millions of gallons of water daily for cooling, heating, cleaning, flushing and other functions necessary for their operations. Slurry pump shaft seals, for example, can use thousands of gallons a year to protect and prolong their life. In the process, they create a vicious cycle of wasting water.

Abrasive slurries such as those pumped by paper mills, coal-fired power plants and mining operations destroy seals when they come into contact with them. One solution is to use massive volumes of water to flush and cool the seals.

Unfortunately, this approach wastes enormous amounts of water and dilutes the media, adversely affecting process efficiency. Moreover, superfluous "tramp" water has to be removed from the process media, which requires the consumption of additional energy.

A better solution is to stop this cycle before it begins by using a seal that will provide the required longevity, consumes little or no water, and introduces little or no water to the process (see Figure 2).

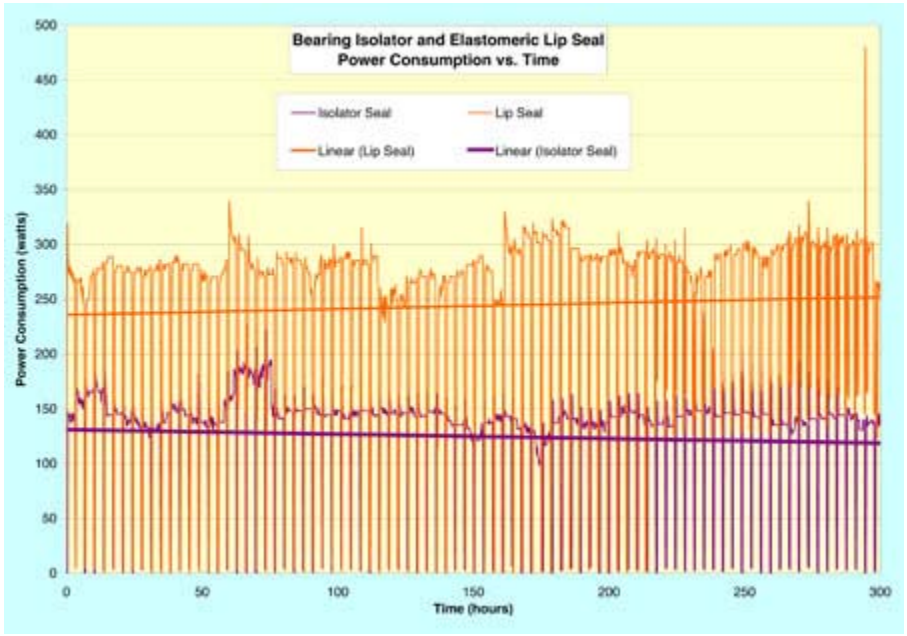
Figure 2. This rotary shaft sealing system is designed to replace mechanical seals in pumping applications. Its dry, no-dilution performance minimizes water consumption.

Energy Consumption

Contact seals apply a significant amount of friction on rotating pump shafts and reciprocating valve stems, resulting in wasted energy. If feasible, using bearing isolators instead of elastomeric lip seals in these applications can reduce energy consumption by up to 50 percent (see Figure 3).

Figure 3. This chart graphically demonstrates the dramatic reduction in power consumption by using bearing isolators in pump and valve applications.

Indeed, conservation is the highest form of environmental responsibility. It is the responsibility of the sealing industry to provide solutions that minimize or eliminate the environmental impact of the



systems in which they are installed. At the same time, however, they also must meet the productivity requirements of the companies that use them. The products to meet these seemingly incompatible, but actually complementary, objectives are either already available, in development or being formulated in someone's laboratory.

Jim Drago, P.E., has worked in sealing technology for more than 25 years. His work has focused on engineering, applications, product development and management. He has authored numerous articles on sealing to meet fugitive emission regulations, presented papers at technical symposiums and contributed to the formulation of industry standards and guides for API, ASME, EPRI and STLE.

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